PATENT SPECIFICATION

657,080

Date of filing Complete Specification: Jan. 6, 1950.

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COMPLETE SPECIFICATION

SPECIFICATION NO. 657080

INVENTOR:- WILLIAM HENRY TAIT

By a direction given under Section 17(1) of the Patents Act 1949 this application proceeded in the name of The Glacier Metal Company Limited, a British Company, of 368, Ealing Road, Alperton, Wembley, Middlesex.

THE PATENT OFFICE,
11th September, 1951

DS 92518/1(13)/5673 180 8/51 R

described in and by the following statement:—

This invention relates to plain bearings or the like, the term "plain bearings" including journal bearings, thrust bearings and flat anti-friction elements for sliding contact, e.g. gas meter grids or similar slidable elements.

The invention has for its object to provide an improved bearing structure or bearing facing adapted for operation without the use of an intermediate separating film of oil or other lubricant.

It is known that a synthetic compound consisting of polymerised tetra-fluoro-ethylene possesses good anti-friction properties for use with steel or other usual journal materials and that it retains these properties in the absence of an intermediate separating film of oil or other lubricant and at temperatures up to about 280° C.

However, this compound has two disadvantages. In the first place it possesses a high co-efficient of thermal expansion which, on any substantial variation in temperature, will change the clearance between the bearing and journal or thrust face to cause excessive tightness with increased temperature or excessive looseness when cooled again to atmospheric temperature. In the second place it possesses low heat conductivity with the result that the surface layers of a bearing are liable to overheat above the transition temperatur (327° C.).

These disadvantages render the compound in itself unsuitable for successful application to practical bearing problems,

ture of a suitable metal or metal alloy, for instance, silver or like soft metal or a suitable alloy of such metals.

The metallic structure preferably is of open character adapted to support and substantially surround or retain discrete particles of the synthetic compound. For instance, the metallic structure may be of sponge-like or similar form, or in the form of a wire mesh or gauze or metallic wool.

A duplex structure embodying such an open metallic face presents, at least initially, a bearing surface in which the metallic and non-metallic elements are interspersed. Advantageously, the texture of the open metallic structure is so fine that in use a continuous smear of the non-metallic compound is wiped over the exposed metallic bearing surface.

The incorporation of the non-metallic compound in the open metallic structure serves to compensate for the low heat conductivity of the compound and also serves to limit the effect of thermal expansion of the non-metallic compound.

An open metallic structure may be produced by sintering a suitable mixture of powders of the synthetic compound and a suitable metal, such as silver or metal alloy, whereby a duplex structure may be attained in which the metallic and non-metallic elements appear as interlaced sponges of fine texture.

Alternatively, an open metallic structure may be preformed. For example, it may be in the form of wire mesh or gauze made from a suitable metal, or in the

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COMPLETE SPECIFICATION

Improvements in or relating to Plain Bearings or the like

We, THE GLACIER METAL COMPANY LIMITED, of 368, Ealing Road, Alperton, Wembley, in the County of Middlesex, a British Company, and WILLIAM HENRY TAIT, of the Company's address, a British Subject, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to plain bearings or the like, the term "plain bearings" including journal bearings, thrust bearings and flat anti-friction elements for sliding contact, e.g. gas meter grids or similar slidable elements.

The invention has for its object to provide an improved bearing structure or bearing facing adapted for operation without the use of an intermediate separating film of oil or other lubricant.

It is known that a synthetic compound consisting of polymerised tetra-fluoroethylene possesses good anti-friction properties for use with steel or other usual journal materials and that it retains these properties in the absence of an intermediate separating film of oil or other lubricant and at temperatures up to about 280° C.

However, this compound has two disadvantages. In the first place it possesses a high co-efficient of thermal expansion which, on any substantial variation in temperature, will change the clearance between the bearing and journal or thrust face to cause excessive tightness with increased temperature or excessive looseness when cooled again to atmospheric temperature. In the second place it possesses low heat conductivity with the result that the surface layers of a bearing are liable to overheat above the transition temperatur (327° C.).

These disadvantages render the compound in itself unsuitable for successful application to practical bearing problems, particularly when severe load conditions are likely to be encountered.

More specifically, the present invention has for its object to utilise the good anti-friction properties of the synthetic compound referred to while avoiding the disadvantages referred to above.

According to the present invention, a plain bearing comprises poly-tetra-fluoroethylene incorporated in a metallic structure of a suitable metal or metal alloy, for instance, silver or like soft metal or a suitable alloy of such metals.

The metallic structure preferably is of open character adapted to support and substantially surround or retain discrete particles of the synthetic compound. For instance, the metallic structure may be of sponge-like or similar form, or in the form of a wire mesh or gauze or metallic wool.

A duplex structure embodying such an open metallic face presents, at least initially, a bearing surface in which the metallic and non-metallic elements are interspersed. Advantageously, the texture of the open metallic structure is so fine that in use a continuous smear of the non-metallic compound is wiped over the exposed metallic bearing surface.

The incorporation of the non-metallic compound in the open metallic structure serves to compensate for the low heat conductivity of the compound and also serves to limit the effect of thermal expansion of the non-metallic compound.

An open metallic structure may be produced by sintering a suitable mixture of powders of the synthetic compound and a suitable metal, such as silver or metal alloy, whereby a duplex structure may be attained in which the metallic and non-metallic elements appear as interlaced sponges of fine texture.

Alternatively, an open metallic structure may be preformed. For example, it may be in the form of wire mesh or gauze made from a suitable metal, or in the

form of a metallic wool, the interstices being loaded with the powdered synthetic compound and the composite material being subjected to heat and pressure for the incorporation of the compound in the metallic support.

In carrying the invention into effect according to a particular embodiment, and in the application of the invention particularly to the production of a bearing bush for use with a steel shaft or journal, poly-tetra-fluoro-ethylene in powder form and silver in powder form are mixed in the ratio of five parts by volume of silver to one part by volume of the synthetic compound, both powders being sufficiently fine to pass through a 100 mesh screen. The mixed powder is then cold-pressed in a suitable die, the pressure being sufficient to compact the mixed powders into a moulded but "uncured" form sufficiently coherent for handling. This moulded form is then sintered in an atmosphere of cracked ammonia, i.e. a mixture of nitrogen and hydrogen produced by the disassociation of ammonia, at a temperature of about 360° C. for about one hour. While still hot the sintered body is pressed in a mould to the exact final shape desired, thereby producing a bush having a duplex structure consisting of silver and poly-tetra-fluoro-ethylene in the form of interlaced sponges of fine texture, which bush may be of any desired size or shape and may be utilised in place of any self-lubricating porous bush of the usual type.

In a further embodiment, and in the application of the invention to the production of a composite thin-walled bearing having a steel, bronze or other suitable backing, a plain blank, for example of steel of suitable dimensions for subsequent forming to cylindrical or semi-cylindrical form, is electro-plated with a layer of copper about 0.0005 inches thick, and thereafter with a layer of silver 0.0003 inches on its surface. On this electro-plated blank a layer of mixed powders are hereinbefore specified is spread, this layer being of suitable thickness and being cold-pressed with a sufficiently high pressure to ensure that it will remain on the blank as an adherent coating capable of being handled. The composite blank is then sintered in an atmosphere of cranked ammonia at a temperature of 360° C. for about one hour and is then pressed flat while still hot to consolidate the composite structure produced. The blank is then worked into the form of a bush or half-bush by any conventional or suitable method.

In a further modification, applicable more particularly to a thrust washer or facing therefor or to sliding anti-friction elements, such as gas meter grids or the like, wire mesh or gauze made of any suitable metal may be loaded with powdered poly-tetra-fluoro-ethylene as by spreading a layer of the powder on the mesh or gauze and, if desired, after cold-pressing, is subjected to a sufficiently high temperature and pressure for the moulding of the synthetic compound in the metallic structure and its conversion into a solid body.

In a further modification, the metal at the bearing surface may be formed as by pressing or otherwise with small closely spaced pits in its surface which are filled with poly-tetra-fluoro-ethylene, the surface of the metal being pressed during or after suitable heat treatment to compact the poly-tetra-fluoro-ethylene into the pits.

Any other suitable preformed metallic structure, e.g. metallic wool of sufficiently fine texture and loose character to permit of dispersion therein of the powdered poly-tetra-fluoro-ethylene, may be employed.

The metallic structure may be of any suitable metal. Where the metallic structure is formed by sintering metallic powders, the metal must be capable of sintering in a controlled atmosphere at temperatures below 400° C. If the metallic structure is not formed by sintering, other metal or metals may be employed which are generally suitable for bearing purposes.

It will be understood that the invention is not limited to the particular embodiments hereinbefore described and that a duplex structure consisting of an openwork metallic support with the synthetic compound referred to interspersed therein may be produced in any other suitable manner.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A plain bearing comprising poly-tetra-fluoro-ethylene incorporated in a metallic structure.

2. A plain bearing according to Claim 1, wherein the metallic structure is of open character adapted to support and substantially surround or retain discrete particles of the synthetic compound.

3. A plain bearing according to Claim 2, characterised in that the open metallic structure is of fine texture, for the purpose described.

4. A plain bearing according to Claim 2 or Claim 3, characterised in that the open metallic structure is produced by

sintering a suitable mixture of powders of the synthetic compound and a suitable metal or metal alloy.

5. A plain bearing according to Claim 4, wherein the metallic constituent consists of a soft metal, such as silver, capable of being sintered at temperatures below 400° C.

6. A plain bearing according to any of the preceding Claims 1 to 3, characterised in that the open metallic structure is preformed from wire mesh or gauze or metallic wool, the interstices of which are loaded with powdered synthetic compound which is consolidated into the metallic structure by heat and pressure.

7. A plain bearing according to any of the preceding Claims 1 to 3, wherein the metal at the bearing surface is formed with small closely spaced pits which are filled with the synthetic compound, the surface of the metal being prssed during or after suitable heat treatment to compact the synthetic compound into the said pits.

8. The method of producing plain bearings according to any of the preceding claims, substantially as hereinbefore described.

9. A plain bearing, thrust washer, or sliding anti-friction element, comprising discrete particles of poly-tetra-fluoro-ethylene incorporated in a supporting metallic structure, substantially as hereinbefore described.

Dated this 5th day of January, 1950.

URQUHART-DYKES & LORD,
Chartered Patent Agents,
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and
12, South Parade, Leeds 1, Yorks.

PROVISIONAL SPECIFICATION

Improvements in or relating to Plain Bearings or the like

We, THE GLACIER METAL COMPANY LIMITED, of 368, Ealing Road, Alperton, Wembley, in the County of Middlesex, a British Company, and WILLIAM HENRY TAIT, of the Company's address, a British Subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to plain bearings or the like, the term "plain bearings" including journal bearings, thrust bearings and flat anti-friction elements for sliding contact, e.g. gas meter grids or similar slidable elements.

The invention has for its object to provide an improved bearing structure or bearing facing adapted for operation without the use of an intermediate separating film of oil or other lubricant.

It is known that a synthetic compound consisting of a polymerised tetra-fluoro-ethylene possesses good anti-friction properties for use with steel or other usual journal materials and that it retains these properties in the absence of an intermediate separating film of oil or other lubricant and at temperatures up to about 280° C.

However, this compound has two disadvantages. In the first place it possesses a high co-efficient of thermal expansion which, on any substantial variation in temperature, will change the clearance between the bearing and journal or thrust face to cause excessive tightness with increased temperature or excessive looseness when cooled again to atmospheric temperature. In the second place it possesses low heat conductivity with the result that the surface layers of a bearing are liable to overheat above the transition temperature (327° C.).

These disadvantages render the compound in itself unsuitable for successful application to practical bearing problems, particularly when severe load conditions are likely to be encountered.

More specifically the present invention has for its object to utilise the good anti-friction properties of the synthetic compound referred to while avoiding the disadvantages referred to above.

According to the present invention, a plain bearing or facing therefor comprises poly-tetra-fluoro-ethylene incorporated in an open metallic structure of a suitable metal or metal alloy, for instance, silver or like soft metal or a suitable alloy of such metals.

The duplex structure embodying a metallic phase supporting and substantially surrounding discrete particles of the non-metallic compound presents, at least initially, a bearing surface in which the metallic and non-metallic elements are interspersed.

Advantageously, the texture of the open metallic structure is so fine that in use a continuous smear of the non-metallic compound is wiped over the exposed metallic bearing surfaces.

The incorporation of the non-metallic compound in the open metallic structure serves to compensate for the low heat conductivity of the compound and also serves to limit the co-efficient of thermal expansion.

The open metallic supporting structure preferably is produced by a sintering

operation on a suitable mixture of the compound and a suitable metal, such as silver, both in the form of powder, whereby a duplex structure may be attained in which the metallic and non-metallic elements appear as interlaced sponges of very fine texture.

Alternatively, the metallic structure may be preformed. For example, it may be in the form of wire mesh or gauze made from a suitable metal, or in the form of a metallic "wool," the interstices being loaded with the powdered synthetic compound and the composite material being subjected to heat and pressure for the incorporation of the compound in the metallic support.

In carrying the invention into effect according to a particular embodiment, and in the application of the invention particularly to the production of a bearing bush for use with a steel shaft or journal, poly-tetra-fluoro-ethylene in powder form and silver in powder form are mixed in the ratio of five parts by volume of silver to one part by volume of the synthetic compound, both powders being sufficiently fine to pass through a 100 mesh screen. The mixed powder is then cold-pressed in a suitable die, the pressure being sufficient to compact the mixed powder into a moulded but "uncured" form sufficiently coherent for handling. This moulded form is then sintered in an atmosphere of cracked ammonia, i.e. a mixture of nitrogen and hydrogen produced by the disassociation of ammonia, at a temperature of about 360° C. for about one hour. While still hot the sintered body is pressed in a mould to the exact final shape desired, thereby producing a bush having a duplex structure consisting of silver and poly-tetra-fluoro-ethylene in the form of interlaced sponges of fine texture, which bush may be of any desired size or shape and may be utilised in place of any self-lubricating porous bush of the usual type.

In a further embodiment, and in the application of the invention to the production of a composite thin-walled bearing having a steel, bronze and other suitable backing, a plain blank, for example of steel of suitable dimensions for subsequent pressing to cylindrical or semi-cylindrical form, is electro-plated with a layer of copper about 0.0005 inches thick, and thereafter with a layer of silver 0.0003 inches on its surface. On this electro-plated blank a layer of mixed powders as hereinbefore specified is spread, this layer being of suitable thickness and being cold-pressed with a sufficiently high pressure to ensure that it will remain on the blank as an adherent coating capable of being handled. The composite blank is then sintered in an atmosphere of cracked ammonia at a temperature of 360° C. for about one hour and is then pressed flat while still hot to consolidate the composite structure produced. The blank is then pressed into the form of a bush or half-bush by any conventional method.

In a further modification, applicable more particularly to a thrust washer or facing therefor or to sliding anti-friction elements, such as gas meter grids or the like, wire mesh or gauze made of any suitable metal may be loaded with powdered poly-tetra-fluoro-ethylene as by spreading a layer of the powder on the mesh or gauze and, if desired, after cold-pressing, is subjected to a sufficiently high temperature and pressure for the moulding of the synthetic compound in the metallic structure and its conversion into a solid body.

In a further modification, a metal surface may be formed as by pressing or otherwise with small closely spaced pits in its surface which are filled with poly-tetra-fluoro-ethylene, the surface of the metal being pressed during or after suitable heat treatment to compact the poly-tetra-fluoro-ethylene into the pits.

Any other suitable preformed metallic structure, e.g. metallic "wool" of sufficiently fine texture and loose character to permit of dispersion therein of the powdered poly-tetra-fluoro-ethylene, may be employed.

The metallic structure may be of any suitable metal. Where the metallic structure is formed by sintering metallic powders, the metal must be capable of sintering in a controlled atmosphere at temperatures below 400° C. If the metallic structure is not formed by sintering, other metal or metals may be employed which are generally suitable for bearing purposes.

It will be understood that the invention is not limited to the particular embodiments hereinbefore described and that a duplex structure consisting of an open-work metallic support with the synthetic compound referred to interspersed therein may be produced in any other suitable manner.

Dated this 11th day of January, 1949.

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